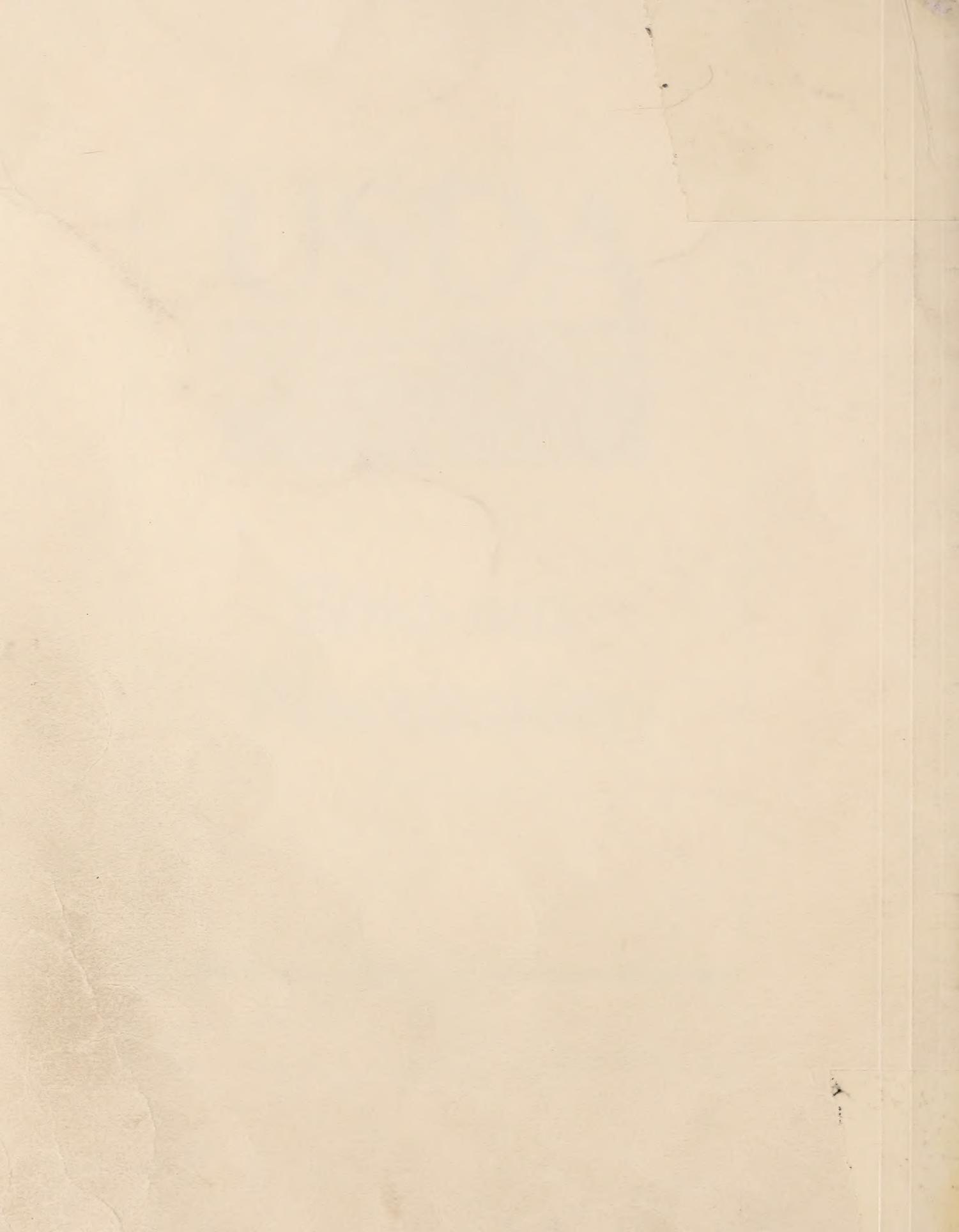


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United States  
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Pacific Northwest  
Research Station

Research Note  
PNW-RN-522  
September 1997



# Research Information Needs on Terrestrial Vertebrate Species of the Interior Columbia River Basin and Northern Portions of the Klamath and Great Basins: A Research, Development, and Application Database

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## Abstract

Research information needs on selected invertebrates and all vertebrates of the interior Columbia River basin and adjacent areas in the United States were collected into a research, development, and application database as part of the Interior Columbia Basin Ecosystem Management Project. The database includes 482 potential research study topics on 232 individual species and 18 species groups of animals, representing significant gaps in scientific knowledge. Research study topics in the database can be retrieved by use of keyword searches. Keyword subjects include basic ecology, distribution, inventory and monitoring, environmental disturbance, effects of land use management activities, and other topics. Research study topics can be prioritized once a land management plan is in place for the basin and an assessment is conducted of risk management on species and their environments. The database is included on computer files available on the World Wide Web at URL <http://www.fs.fed.us/pnw/marcot.html>.

**Keywords:** Research needs, information needs, amphibians, reptiles, birds, mammals, wildlife, interior Columbia River basin, Klamath Basin, Great Basin, inventory, monitoring.

## Background and Introduction

During 1993-96, the Science Integration Team (SIT) of the Interior Columbia Basin Ecosystem Management Project (ICBEMP), USDA Forest Service and USDI Bureau of Land Management, engaged in an assessment of the economic, social, ecological, and biological conditions of the interior Columbia River basin and northern portions of the Klamath and Great Basins (hereafter, "assessment area") (Quigley and Arbelbide, in prep.). One part of the ICBEMP charter directed the development of a foundation for research, development, and applications (RD&A) activities, by identifying scientific knowledge critical to ensuring long-term sustainable management and ecological integrity of the inland ecosystems and communities. One facet of this mandate entailed identifying gaps in scientific knowledge of the ecology of species and ecosystems. This report presents results of the evaluation of research information needs on terrestrial species of the assessment area.

## Methods

The terrestrial ecology staff of SIT gathered information on species-environment relations of rare plants, selected invertebrates, and all vertebrates occurring within the assessment area (Marcot and others, in prep.). One part of this information dealt with identifying areas of scientific uncertainty and further research information needs on

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species. Areas of scientific knowledge gaps were identified by reviewing the literature, from discussions with agency and other biologists, and by soliciting brief written appraisals from individual experts.

During panel meetings in which base ecological information was gathered on species-environment relations, experts were asked to record key areas of scientific knowledge gaps for each species that would provide critical data for the compilation of the species-environment relations (SER) database and to meet the need for effective ecosystem management. Marcot and others (*in prep.*) describe the paneling process and experts involved. The terrestrial ecology staff also worked with numerous agency biologists and researchers to determine ongoing and needed studies.

Species information needs were then compiled into a database on a personal computer by using the RD&A software program of Hessburg and others (1994), which is a compiled script written for the Paradox<sup>1</sup> relational database program. The RD&A software allows each research study need to be briefly summarized with a study description, statement of potential application, and up to six keywords for later retrieval. The RD&A database, however, is available separately from the program, as a standard .db format file.

Separate RD&A databases on research study needs were developed for plants (rare or potentially rare taxa and rare plant communities) and animals (selected invertebrates and all vertebrates). One joint set of keywords was developed for all plant and animal entries (table 1). Keywords were then grouped (table 2), which aid retrieving study needs by general subject area.

This paper presents results on animals. The plants portion of the RD&A database will be presented elsewhere by the plant task group of the terrestrial ecology staff.

Some vertebrate species, mostly those of aquatic environments, were combined into species groups in the SER database. In these cases, their collective research information needs also were addressed as species groups in the RD&A database. These 18 species groups are listed in table 3. Remaining species were listed individually in both the SER and RD&A databases.

I do not discuss specific priorities for species research topics in this paper. Specific research priorities should arise from a fuller evaluation of risk management, including selection of a planning alternative for Federal lands managed in the assessment area and an evaluation of which environments and associated species may be at greatest risk under such a plan. The SER and RD&A databases collectively can help in setting research priorities once such a plan has been selected and is in place, by identifying species associated with at-risk environments and their research needs.

## Results

Some 482 potential study topics spanning 232 individual species and 18 species groups are identified in the RD&A animals database. The topics are indexed by 135 keywords; some keywords pertain only to plants or only to animals, and others pertain to both. The RD&A database represents knowledge gaps pertinent to completing the SER database on species and for providing management with information on numerical or ecological status of species of potential concern. Doubtless, many additional

<sup>1</sup> The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

potential research topics could and should be identified. The RD&A database, and other research needs results summarized in this report, are offered as only one collection of information needs that should be weighed along with ancillary and more local considerations.

The information needs identified here are mostly pertinent to the broad assessment area, although many research topics in the RD&A database identify portions of states in which the information is lacking. Information gaps and study needs also should be identified and refined for specific field management units. I strongly suggest that this be done by ecoregional boundaries rather than state, agency, or administrative unit boundaries.

#### **Research Needs Identified by Topic**

By far, the greatest number of research study needs on species were identified under the broad headings of habitat selection and use (keyword HABITAT, 174 entries) and population demography and dynamics (keyword POPULATION, 165 entries). The many entries under these two topics underscore the rather broad lack of species-specific knowledge of habitat use and population ecology in the assessment area. Much basic work remains to be done to verify the habitat relations depicted in the SER database and to determine population status of many species.

Other research topics with a large number of entries (>75) in the RD&A database included studies of life history (keyword LIFE HISTORY) and monitoring (keyword MONITORING). At least 71 individual species and 1 species group were identified for which there are substantial gaps in knowledge of basic life history in the assessment area. Assuredly, many other species, including most invertebrates, could be added to this list. Similarly, at least 60 individual species and about 10 species groups were identified for which monitoring of trends may be useful. In addition, field monitoring methods need to be developed for at least 11 species, including 3 mustelids, 3 other carnivores, a deer, 2 birds, and others.

Other research topics garnering a substantial but lower number of total entries (>20) included studies on species groups (keyword BATS), presence (DISTRIBUTION, INVENTORY), interspecific interactions (COMPETITION, PREDATION), demography (REPRODUCTION), behavior (DIET, DISPERSAL, MIGRATION), environmental factors (FIRE), and management activities (GRAZING, LOGGING, PESTICIDES). In reviewing the RD&A database, it became evident that there is a substantial lack of knowledge of basic distribution and ecology of bats in the assessment area. There is a lack of information on basic distribution of many other species as well, as listed in the RD&A database. Studies of interspecific interactions, demography, and behavior may be important for identifying potential conservation concern for some species. And knowledge of effects of management activities on species can be useful for crafting application guidelines.

The remaining topics garnered fewer entries per topic, but they still may be crucial for specific species. The remaining topics include additional areas of management (AGRICULTURE, ANIMAL DAMAGE, CHEMICAL POLLUTION, DEVELOPMENT, DISTURBANCE, EXOTICS, HABITAT FRAGMENTATION, HUNTING, TRAPPING, RECREATION, ROADS), species groups (SOIL BACTERIA, DISEASE, FUNGI, INVERTEBRATES, INVERTEBRATE PLANT HOSTS, POLLINATORS), environmental change (CLIMATE AND WEATHER), basic ecology (FOOD WEBS, HOME RANGE, HYBRIDIZATION, REFUGIA, ROOSTS, SOIL, SUCCESSION), systematics (GENETICS, TAXONOMY), habitats (OLD GROWTH FORESTS), and modeling (MODELS).

## **Studies Needed on Systematics and Taxonomy**

Far from academic questions of zoology and taxonomy, systematics studies are fundamental to determining the occurrence of taxonomic groups (species and subspecies) in the assessment area as a prelude to identifying key conservation concerns of local or regional endemics or rare taxa. I will expand on this topic here because it is of such fundamental importance, and also as an example of information to be found in the RD&A database.

The results of querying the RD&A database on TAXONOMY revealed 14 potential research study topics. Results supported our earlier contention that basic studies remain to be done on taxonomy and systematics of some individual species and species complexes (Marcot and others, in prep.). Systematics studies are needed on a wide array of invertebrates. As identified in Marcot and others (in prep.):

Many species of arthropods, particularly canopy-dwelling forest arthropods and soil mesoinvertebrates, remain undescribed. About 86 percent of arthropods, 67 percent of fungi, and 51 percent of mollusk species estimated to occur in the assessment area have not been studied, surveyed, or, in some cases, even identified. Much inventory and basic systematics work remains to be done on these groups. Soil microorganism groups and microbiotic (soil) crusts of the assessment area, although critical for maintaining soil productivity, are poorly known and little studied.

Most of the soil microbiota of the assessment area is undescribed. This biota includes viruses, bacteria, protozoa, rotifers, nematodes, and soil microfungi, as well as algae. Even though we consider such taxa as species groups, basic empirical work still is needed on taxonomy, diversity, and ecological roles of these species, particularly in how they aid soil productivity and maintain health of forest and rangeland ecosystems.

Additional systematics work is also needed on selected vertebrate species. Specifically, among amphibians, such studies would help determine whether the Idaho giant salamander (*Dicamptodon aterrimus*) is conspecific with the Pacific giant salamander (*D. tenebrosus*), as their species status is in some doubt. Systematics of the tiger salamander (*Ambystoma tigrinum*) also needs much work; some experts suspect that several species might comprise the current single species.

Among reptiles, the systematics of garter snakes need much work throughout the west, including western terrestrial garter snake (*Thamnophis elegans*) and subspecies of common garter snake (*T. sirtalis*). One question, in particular, is if variants of the valley garter snake subspecies (*T. s. fitchi*) in Idaho, Washington, and Oregon warrant separate additional subspecies status.

Systematics studies also are needed on short-horned lizard (*Phrynosoma douglassi*). Geographic variation in populations of the Mojave black-collared lizard (*Crotaphytus bicinctores*) needs study to determine if these are subspecies or distinct species. Studies are also needed on the northern alligator lizard's (*Elgaria coerulea*) geographic variations, and degrees of intergrades with the southern alligator lizard (*E. multicarinata*), to better determine the taxonomic status of subspecies and species in the assessment area.

Among birds, systematics studies would be useful for revealing the validity of western subspecies of sage grouse (especially *Centrocercus urophasianus phaios*). Studies of the Canada goose (*Branta canadensis*) are needed on relative abundance and percentages of various races and populations, to better determine the taxonomic mix of races in the assessment area, and thus the population status for use in setting hunting guidelines and habitat management. Taxonomic studies of black rosy finch (*Leucosticte arctoa*) would help determine the status of species and subspecies, especially in the Wallowa Mountains where intergrades ("*Leucosticte arctoa tephrocotis*") occur between black and gray-crowned rosy finches (*L. tephrocotis*). It is unclear if these intergrades represent potentially recent hybrids, an endemic relict subspecies, or even early stages of speciation (emergence of a new species lineage).

Among mammals, the pocket gopher complex (Geomyidae) needs studies on systematic affinities of some taxa, especially western pocket gopher (*Thomomys mazama*). Studies are needed also to determine taxonomic affinity between vagrant shrew (*Sorex vagrans*) and montane shrew (*S. monticolus*). Even the common deer mouse (*Peromyscus maniculatus*) has not been adequately studied taxonomically; population genetics and subspecies status need refinement, as some authorities (for example, Ingles 1965) separate the forest deer mouse (*P. oreas*) in the Cascade Range as a separate species. This is also a good species with which to conduct further studies of dynamics of speciation, clines, variations in protective coloration, genetic variability, metapopulation dynamics, and adaptive evolution.

#### **Studies Needed on Effects of Grazing**

In another example, I queried the RD&A database on species research studies needed on grazing, which includes effects of livestock grazing in the assessment area and ecology of wildlife herbivory. Results, listing the 29 research topics in the RD&A database related to grazing, are shown in appendix 1 as an example of the database contents. Other studies needed on grazing aside from those on terrestrial wildlife species are discussed in Quigley and Arbelbide (in prep.).

#### **Species and Systems: Which to Study?**

Presenting research needs on species does not mean that I advocate strictly a species-by-species approach to wildlife management. A far greater efficiency and breadth of coverage can be attained by merging selected species management and integrated research with broader scope management and research of ecosystem processes and conditions. This is not to avoid difficult questions about trends of, and management effects on, at least some individual priority species. The studies identified here are intended to help identify real knowledge gaps for potential use in joining species and systems approaches to management, once management direction for the CRB assessment area has been determined.

Additional research information needs beyond species studies were identified by Marcot and others (in prep.) and are summarized here in table 4 for invertebrates and in table 5 for vertebrates. Also, studies of biological entities other than species may be important for their evolutionary and biodiversity significance (Marcot and others, in prep.). These include studies of ecological functional groups of species, isolated or disjunct populations, edges of distributional ranges of species, coevolved species complexes, sibling or cryptic species complexes, keystone species, local endemics, and ecotypes. Such studies could help meet the goals of ecological integrity as identified by SIT (Haynes and others 1996).

## **Availability**

The RD&A database and its metadata documentation discussed in this research note are available on the World Wide Web at URL <http://www.fs.fed.us/pnw/marcot.html>. The metadata documentation is also included in this report (see appendix 2).

## **Acknowledgments**

I thank John Lehmkuhl for a helpful review of the manuscript. I am particularly grateful to the many experts who submitted contract or internal reports and participated on panels to provide information on research information needs during the Interior Columbia Basin Ecosystem Management Project. Robert Naney, Kurt Nelson, Christine Niwa, Roger Sandquist, and Barbara Wales helped organize the panels and provided information. Barbara Wales and the GIS and computer support staff led by Becky Gravenmier helped record the panel data in preliminary databases. Diane Smith and Cheryl Pittman have facilitated posting this paper and the databases on the World Wide Web. Responsibility for the content of the database rests solely with me.

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup>**

Keyword	Definition of keyword
ADD SPECIES	potential additions to the list of C-2 candidate plant species as used by U.S. Fish and Wildlife Service (suggested by the Oregon Basin and Range Plant Panel, ICBEMP)
AGRICULTURE	various aspects of agricultural development: agricultural conversion of species habitat, hydrological changes associated with agricultural practices (drainage, irrigation projects), chemical pollution of waterways, or use of herbicides for the control of exotics in agricultural croplands
AMPHIBIAN	taxonomic class
ANIMAL DAMAGE	adverse effects on desired plants (tree plantations, crops, etc.) by physical damage or by consumption by wild animals (e.g., ungulates, rodents, lagomorphs)
BACTERIA	taxonomic group
BAT	taxonomic order (Chiroptera)
BIODIVERSITY	species groups, habitats, centers of endemism, or locations rich in numbers of species
BIRD	taxonomic class
BM	plant information from the Blue Mountains Expert Panel, ICBEMP
BOATING	impacts associated with recreational boating, as potential sources of threat to plant species
BOGS	species group or habitat identifier
BR-OU	plant information from the Oregon Basin and Range, Owyhee Uplands Expert Panel, ICBEMP
CB	plant information from the Columbia Basin Expert Panel, ICBEMP; pertains to Oregon, Washington, or both
CHEM. POLLUTION	chemical pollution of terrestrial or aquatic systems (such as waterways associated with agriculture) as a potential affect on (usually threat to) species or habitats
CLIMATE	potential effects on species or habitats from weather conditions, especially climatic change (also see GLOBAL WARMING)
COLLECTION	potential effects on species or habitats from the collection of specimens in the wild (for example, for horticultural propagation of plants)

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
COMPETITION	competitive interaction among species, including effects from exotic species and deliberately seeded nonnative plant species
CONS. STRATEGY	refers to the need for completion of conservation strategy guides for key plant species, as a high priority for effective management of the species, or its habitat, or both
CRYPTOGAM	nonflowering plant species, or plant species closely and symbiotically associated with nonflowering plant species
DEVELOPMENT	effects of housing, agricultural, or recreational development as a potential threat to species or habitats
DIET	for animals, refers to prey selection or prey ecology
DISEASE	pathogens as a potential threat to species; for plants, the usual context was fungal destruction of seeds
DISPERSAL	movement of organisms or disseminules, including dispersal mechanisms, ecology, requirements, and rates; for animals, one-time movements from natal areas (compare with MIGRATION)
DISPLACEMENT	potential exclusion of plant species from their natural habitat, by the invasion of exotics or by inundation of habitat associated with the pool levels behind hydroelectric dams
DISTRIBUTION	geographic range of the species of concern; implies that range is not well documented and that inventory for the species is needed
DISTURBANCE	changes in environmental conditions from human activities, as affecting species viability; includes soil disturbance, changes in the light regime, changes in fire regime, and changes induced by grazing and other management activities
EC/HP	plant information from the Oregon East Cascades/High Lava Plains Expert Panel, ICBEMP
ECN	plant information from the Washington East Cascades North Expert Panel, ICBEMP
EDGE	ecotones between vegetation patches, such as mature forest and early successional forest; closely associated with habitat FRAGMENTATION

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
ELECTROPHORESIS	indicates that electrophoretic analysis can resolve questions of plant taxonomy, or can lead to an understanding of the impacts of genetic introgression by sympatric plant species
ENDEMISM	"Centers of endemism" group records for plants
EVOLUTION	indicates investigation into plant speciation in response to edaphic variation
EXCAVATION	development of gravel pits or bentonite mines as potential threats to plant species, habitats, biodiversity centers, or centers of endemism
EXOTICS	invasion of habitat by exotics species, including nonnatives deliberately included in seeding (plant) or transplant (animal) activities
FERN	taxonomic plant group: vascular cryptogam; that is, a fern or "fern ally"
FIRE	effects of human-induced changes in fire occurrence, fire regimes, or fire suppression activities; applies to effects on species, centers of endemism, and biodiversity
FIREWOOD	potential effects by fuelwood harvest
FOOD WEBS	trophic relations and predator-prey relations among species (see also PREDATION and DIET for animals)
FORB	herbaceous, vascular, flowering plant species; forbs are annual, biennial, or perennial herbaceous species
FRAGMENTATION	human-induced fragmentation of habitat; for plants, refers to negative effects on reproduction (pollination, or dispersal, or both)
FUEL LOAD	artificially elevated fuel loads resulting from fire suppression, as a potentially serious threat to the species, habitats, centers of endemism, or floristic biodiversity
FUNGUS	potential effects on plants from fungal pathogens, usually through destruction of propagules; also refers to a poorly understood symbiotic relation between a plant species and fungus

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
GENETICS	for animals, refers to questions of population genetics as affecting viability; for plants, refers to genetic analysis (cytogenetics, electrophoresis, etc.) as a means to resolve taxonomic problems, or to determine the degree to which introgression by sympatric species is threatening genetic integrity of species
GEOG. AMPLITUDE	for plants, refers to geographic distribution of species not being well understood, and that more extensive inventories for the species are needed; for animals, see DISTRIBUTION
GEOLOGY	natural geologic processes such as landslides, etc., as potentially affecting species and habitats
GERMINATION	reproductive biology of plant species, particularly to seed germination, as problematic
GLOBAL WARMING	regional climate change, and particularly global warming, as potentially affecting species, habitats, centers of endemism, and biodiversity (also see CLIMATE)
GRAMINOID	life form group: grasslike plants not belonging to the family Poaceae (grasses); includes sedges and rushes
GRASS	member of the family Poaceae; grasses are annuals or perennials
GRAZING	potential effects from grazing activities on species, habitats, centers of endemism, and floristic biodiversity
HABITAT	environmental conditions of species; for plants, also implies either that the habitat of the species of concern was limited and threatened or that the record of information supporting the entry was for a plant species group
HERBICIDES	potential effects from application of herbicides; for plants, refers to indirect (drift) and direct (roadside spraying) application of herbicides
HOME RANGE	for animals, the area over which they traverse (daily or seasonally) for locating food and other resources
HORTICULTURE	the “taking” of plant specimens for horticultural propagation (and commercialization) as potential threats to the species of concern; also see COLLECTION

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
HOST/PARASITE	refers to a need for better understanding the relation between host and parasite (for plants, particularly for a hemiparasitic <i>Castilleja</i> [Indian paintbrush] species)
HOUSING	potential effects from human housing developments on species, habitats, centers of endemism, and floristic biodiversity
HUNTING	the taking of animals for sport, game, food, pelts, or other uses
HYBRIDIZATION	genetic mixing of two species; for plants, implies that expert panelists considered genetic introgression by sympatric species to be problematic, where genetic and electrophoretic studies would document this problem and enable its resolution
HYDRO. DAMS	construction and presence of hydroelectric dams and the fluctuations of pool levels behind them
HYDROLOGY	alterations in the hydrologic regime through the construction of drainage channels, roads, hydroelectric dams, or hydrothermal development
HYDROTHERMAL	hydrothermal development and diversion; for plants, the context relates to recreational development around hot springs
ID	plant information from the Idaho panel
INSECT	taxonomic group Insecta; for animals, refers to relations with insect populations as agents of habitat change or as food
INSECT DAMAGE	refers to potential adverse effects on species or habitats from insects
INSECTICIDE	potential effects from pesticides; for plants, refers to the destruction of pollinators by the use of insecticides as a potential threat to species
INTERIOR	conditions in the interior of vegetation patches, mostly forests, as distinguished from EDGE effects
INVENTORY	inventory needs to determine population sizes and geographic distributions of species
INVERTEBRATE	refers to relations with invertebrates as agents of habitat change or as food; also see INSECT

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
KEYSTONE	a species whose ecological function greatly influences the distribution and abundance of many other species
LABORATORY	implies that plant expert panelists identified either laboratory involvement, particularly in electrophoretic resolution of taxonomic problems, or the involvement of laboratory-based seed banks to artificially increase seed supply as potential routes to resolution
LANDSLIDES	natural geologic mass-wasting processes as a potential threat to species
LICHEN	taxonomic group
LIFE HISTORY	implies a need for better understanding of the life history of the species
LOGGING	timber harvest activities and resultant changes in the environment (changes in light regime, changes in hydrology, etc.)
MAMMAL	taxonomic class
MIGRATION	for animals, seasonal movement over relatively long distances
MILITARY	military training maneuvers or the development of bombing ranges, as potentially threatening species
MINING	mining-associated land disturbance activities, as potentially affecting species
MODELS	building of predictive ecology models
MONIT. METHOD	specific monitoring methods for species of concern need to be developed, to provide information on species distribution and for accurate assessment of impacts of activities
MONITORING	trend, demographic, or ecophysiological monitoring is needed
MT	plant information from the Montana Expert Panel, ICBEMP
MYCORRHIZAE	implies a need for understanding the critical role of poorly understood mycorrhizal symbionts
NATIVE FOOD	collection of food species by Native Americans as affecting species or habitats

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
NATIVE MEDICINE	collection of medicinal species by Native Americans as affecting species or habitats
NATIVE SPECIES	use of native species in seeding prescriptions or habitat restoration
NI	plant information from the North Idaho Expert Panel, ICBEMP
NI-OM	plant information from the North Idaho-Overthrust Mountains Expert Panel, ICBEMP
NUTRIENT CYC.	refers to the need for information on nutrient cycling
NV	information on Nevada plant populations, from the Southern Idaho Expert Panel, ICBEMP; implies needs for information on genetics, distribution, inventory of plant species
OH	plant information from the the Washington State Okanogan Highlands Expert Panel, ICBEMP
OLD GROWTH	forests of very late successional stages, or with characteristics associated with such stages, such as large live trees with deep and highly differentiated crowns, large standing dead trees, large down logs, and deep litter or duff layers
PESTICIDES	herbicides and insecticides
PHARMACOLOGY	collection of medicinal species by Native Americans as affecting species or habitats (also see NATIVE MEDICINE)
PL. ASSOCIATION	implies a need for greater understanding of plant association dynamics and particularly successional aspects, as critical for the conservation of plant species (also see SUCCESSION)
PL. COMMUNITY	implies a need for greater understanding of plant community dynamics as critical for the conservation of plant species (also see PL. ASSOCIATION)
PLANT HOST	for invertebrates (especially insects), refers to the use of a plant species as host for at least part of the life cycle
POLLINATION	implies a need for greater understanding of the reproductive biology of plant species, as critical information for its conservation

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
POLLINATOR	for insects, refers to the ecological function of acting as a pollinating vector for a plant species
POPULATION	implies a need for greater understanding of various aspects of population dynamics and ecology; for plants, refers to population levels of species of concern to be reaching threshold values and suggested determination of these critical values
PREDATION	for animals, refers to predation rates, predation ecology, or dynamics of predator-prey systems
PREDICTION	use of information for projecting future conditions from models
PROPAGATION	for plants, implies that the method of propagation is not well understood or that artificial propagation of the species is critical for the conservation of the species (also see HORTICULTURE)
RECREATION	recreational activities as affecting a species of concern, its habitat, center of endemism, or center of floristic biodiversity
RECRUITMENT	for plants, refers to the lack of recruitment to be problematic for the species of concern
REFUGIUM	species of concern limited to relict habitat designated as refugia
REPRODUCTION	for plants, implies a need for greater understanding of the life history, environmental requirements, and particularly the reproductive biology of species
REPTILE	taxonomic class
RESTORATION	for vegetation, artificial seed increasing and the use of species of concern into “outplantings” associated with restoration projects as appropriate for the conservation of the species
ROADS	road construction or road maintenance activities
ROOST	for birds and bats, refers to daily or seasonal use of specific sites for resting
SEDIMENTATION	refers to sedimentation as a component of change in the hydrologic regime as affecting species

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
SEED	for plants, implies a need for a better understanding of the reproductive biology, and particularly the rate of viable seed production and longevity
SEED BANKING	for plants, implies that artificial storage and efforts to increase seed lot were considered by expert panelists as crucial to the conservation of the species
SEED PRESCRIPT.	for plants, implies that deliberate introduction of exotic species through seeding prescriptions threatens the species of concern, its habitat, its center of endemism, or its center of floristic biodiversity; also see EXOTICS
SHADE	in the context of timber harvest activities, potential effects of alterations in the light regime through the removal of overstory (also see LOGGING)
SHRUB	plant life form class; species in this class have woody stems (usually several) and are less than 12 feet ( $\pm$ 6 feet) in height
SI	information on plants from the Southern Idaho Panel
SI-BHM	information on plants from the Southern Idaho-Beaverhead Mountains Panel
SI-CV	information on plants from the Southern Idaho-Challis Volcanics
SI-HC	information on plants from the Southern Idaho-Hells Canyon Panel
SI-NBR	information on plants from the Southern Idaho-Northwest Basin and Range Panel
SI-OM	information on plants from the Southern Idaho-Overthrust Mountains Panel
SI-OU	information on plants from the Southern Idaho-Owyhee Uplift Panel
SI-SRB	information on plants from the Southern Idaho-Snake River Basalts Panel
SNOWMOBILING	use of snowmobiles as a potential threat to (plant) species, its habitat, its center of endemism, or its center of floristic biodiversity.
SOIL	refers to soil structure, function, texture, conservation, and ecology; for plants, suggests a need for additional information on the plant-soil relationships

**Table 1—Definitions of keywords used in the research, development, and application (RD&A) database on species research information needs<sup>a</sup> (continued)**

Keyword	Definition of keyword
SPECIATION	implies a need for greater understanding of speciation (for plants, in response to edaphic gradients)
STREAM DYNAMICS	stream dynamics, alterations in hydrologic regime, flooding, etc., as affecting species or habitats
SUCCESSION	effects of, and need for further information on, seral stage requirements for species of concern
TAXONOMY	need for further study on systematics, such as to resolve the taxonomic status of a species, before monitoring or management guidelines are developed; also used in the context of "altered genetic pool" caused by introgression by sympatric species of plants (see GENETICS)
TRAMPLING	potential effects from domestic livestock by physical compression of the soil (mashing) (also see GRAZING)
TRAPPING	collection of animals for sport, commercial use, or other use
WEATHER	effect of proximate climatic conditions (as contrasted with long-term changes in climate as under GLOBAL WARMING and CLIMATE)
WILD HORSES	potential effects from feral horses on plant species and plant habitats
WILDLIFE	for plants, potential effects from overstocking of wild animals as a threat to species of concern, their habitats, centers of endemism, or centers of biodiversity
WINTER	questions of ecology and life history during winter periods
WY	plant information from the Wyoming Expert Panel, ICBEMP

<sup>a</sup>This list pertains to both plants and animals, although individual keywords were used for only plants or only animals.

**Table 2-Some helpful groups of keywords by general topic, for keywords used in the RD&A database (see table 1)<sup>a</sup>**

General topic	Keywords
Plant expert panels and geographic locations	BM, BR-OU, CB, EC/HP, ECN, ID, MT, NI, NI-OM, NV, OH, SI, SI-BHM, SI-CV, SI-HC, SI-NBR, SI-OM, SI-OU, SI-SRB, WY
Plant growth forms or species groups	BOGS, CRYPTOGAM, FERN, FORB, FUNGUS, GRAMINOID, GRASS, SHRUB
Collecting or native use of plants	COLLECTION, HORTICULTURE, NATIVE FOOD, NATIVE MEDICINE, PHARMACOLOGY, PROPAGATION, SEED BANKING
Taxonomic groups	AMPHIBIAN, BACTERIA, BAT, BIRD, INVERTEBRATE, LICHEN, MAMMAL, REPTILE
Management or recreational activities	AGRICULTURE, BOATING, DEVELOPMENT, DISTURBANCE, FIRE, FIREWOOD, FRAGMENTATION, FUEL LOAD, GRAZING, HOUSING, HUNTING, HYDRO. DAMS, HYDROTHERMAL, LOGGING, MILITARY, MINING, RECREATION, ROADS, SNOWMOBILING
Animal effects, rangeland use, or grazing	ANIMAL DAMAGE, GRAZING, TRAMPLING, WILD HORSES, WILDLIFE
Pesticides and pollution	HERBICIDES, INSECTICIDE, PESTICIDES
Aquatic or riparian conditions	HYDRO. DAMS, HYDROTHERMAL, SEDIMENTATION, STREAM DYNAMICS
Geologic conditions	GEOLOGY, LANDSLIDES, MINING
Weather, climate, and climate change	CLIMATE, GLOBAL WARMING, WEATHER
Effects of exotic species	DISPLACEMENT, EXOTICS, SEED PRESCRIPT.
Inventory and monitoring needs	DISTRIBUTION, INVENTORY, MONIT. METHOD, MONITORING
Basic ecology and population biology	COMPETITION, DISEASE, DISPERSAL, DISPLACEMENT, ELECTROPHORESIS, EVOLUTION, FOOD WEBS, GENETICS, GEOG. AMPLITUDE, HABITAT, HOST/PARASITE, HYBRIDIZATION, KEYSTONE, LABORATORY, LIFE HISTORY, POPULATION, PREDATION, REFUGIUM, EPRODUCTION, SPECIATION, TAXONOMY
Animal movement	HOME RANGE, MIGRATION

<sup>a</sup>This is not a complete listing of all keywords.

**Table 3-Vertebrates treated as species groups in the RD&A database<sup>a</sup>**

Taxonomic class	Species groups
Amphibians and reptiles	Larch Mountain salamander, slender salamander, kingsnake, and sharptail snake group
Birds	grebe family species group duck species group freshwater diving duck species group egret family species group loon species group merganser species group red-necked phalarope, Wilson's phalarope group sandpiper, willet, godwit, curlew, plover group sandpiper, yellowlegs, plover, dowitcher group stilt, avocet group tern species group gulls species group yellow rail, sora, virginia rail group
Mammals	jackrabbit species group kangaroo rat, kangaroo mouse species group shrew species group tree squirrel species group

<sup>a</sup>All other species were addressed individually.

**Table 4—Research information needs for invertebrates of terrestrial ecosystems of the interior Columbia basin assessment area, beyond species-specific studies<sup>a</sup>**

Research subject	Description of research needed
Selection of bioindicators	identification of indicators—mostly lichens, bryophytes, plants, and invertebrates (largely soil or canopy arthropods)—for use in monitoring studies of ecosystem trophic health and diversity (see Marcot and others [in prep.] for discussion and potential species lists)
Microorganisms	species-specific approach to microorganism management is not recommended  microorganism species groups present in various grassland, shrubland, forest, and riparian settings  how species groups are affected by management activities  how changes in species groups affect diversity, productivity, and sustainability of resource production
Invertebrate predators	test the working hypothesis that management activities aimed at maintaining only general conditions of soil productivity would also adequately protect taxa or functional groups of soil invertebrates, particularly predators, and their ecological functions  controlled management experiments to determine the distribution, biology, and response to management activities of a few selected arthropod predator species chosen on the basis of rarity, presumed ecological importance, or sensitivity to particular management activities  how forest management affects the process of invertebrate predation
Invertebrate pollinators	sample sandy environments for presence and abundance of pollinator species, particularly for endemic bee species and to determine effects of recreational vehicle use; surveys would determine dunes with particularly high bee diversity and endemism  monitor bee composition and abundance under various management regimes  develop parallel databases on plants and their pollinators

**Table 4—Research information needs for invertebrates of terrestrial ecosystems of the interior Columbia basin assessment area, beyond species-specific studies<sup>a</sup> (continued)**

Research subject	Description of research needed
Invertebrate grassland herbivores	<p>conduct large-scale, controlled, and replicated studies on basic life history and ecological characteristics of pollinators, especially on breeding biology and pollinator behavior</p> <p>effects of reintroductions and evaluate effects of exotic plant and pollinator species</p> <p>effect of range management practices on plant successional changes and effects on associated insect herbivores</p> <p>effects of grazing rotation timing, intensity, spatial and temporal extent, and length of deferment, on invertebrate grassland herbivores</p> <p>in particular, effects of the season of grazing on vegetation regrowth, plant forage quality for grassland invertebrates herbivores, soil compaction, and soil nitrogen content in various grassland types</p> <p>effects of fire interval, intensity, duration, season, patchiness, and spatial extent on plant community composition and diversity and abundance of invertebrate herbivores and predators</p> <p>proposed introductions of exotic organisms to control native pests need to be accompanied by research to determine the effect of the exotic in displacing other native species that perform the same function</p> <p>ecotoxicology of grassland pesticides on invertebrate herbivores, including long-term and residual effects on the entire invertebrate fauna and bioaccumulation in the food chain</p>
Invertebrate forest herbivores	<p>ecological roles of individual insect species, insect assemblages, and associated diseases</p> <p>continue studies of pest species; develop a hazard rating system for a number of species including bark beetles and pests that damage tree regeneration</p> <p>research and monitoring studies can include population monitoring, control of pests such as bark beetles, and use of herbivore assemblages as bioindicators of forest health</p>

**Table 4—Research information needs for invertebrates of terrestrial ecosystems of the interior Columbia basin assessment area, beyond species-specific studies<sup>a</sup> (continued)**

Research subject	Description of research needed
	adaptive management studies can monitor areas treated by different silviculture practices, particularly various intensities of forest thinning and salvage harvests, to determine conditions inducing insect-caused tree damage or mortality
	sample arthropod forest herbivores, particularly butterflies, to index localized and short-term changes in the environment from management practices
	ecosystem functions of invertebrate forest herbivores, including dietary preferences of bats, birds, amphibians, and other predators, and the role of invertebrate herbivores in contributing to wildlife habitat
All invertebrate groups	study invertebrate specialists other than forest insect pests, determine how their ecological functions influence structure and function of ecological communities and growth and production of desired resources
	integrated studies on the role of invertebrates in organic matter decomposition and nutrient cycling, and in providing food bases for vertebrates
	monitor abundance, biomass, richness, and diversity of invertebrates to assess effects of treatments on small spatial scales
	monitor ratio of total bacterivorous nematodes to fungivorous nematodes to help reveal critical dynamics of decomposer microbial food web functions or effects of management practices

<sup>a</sup>Source: Marcot and others, in prep.

**Table 5—Research information needs for vertebrates of terrestrial ecosystems of the interior Columbia Basin assessment area, beyond species-specific studies<sup>a</sup>**

Research subject	Description of research needed
Amphibians	<p>effects of changes in water quality on larval stages</p> <p>influence of vegetation canopy on breeding ponds and streams (shading:sunlight ratios)</p> <p>habitats used for dispersal</p> <p>influence on amphibians and habitats from eutrophication of water bodies and increases in ultraviolet radiation and acid precipitation</p> <p>inventory and monitoring of specific substrates such as down wood, and microhabitat conditions such as deep, moist talus effects on amphibian populations and habitats from livestock grazing and pesticide use</p>
Reptiles	<p>survey for presence of species that:</p> <p>currently seem to be patchily distributed with apparently disjunct populations, to determine occurrence in potentially unoccupied portions of their range</p> <p>are currently listed by agencies as sensitive but which may be more common or widely distributed than originally reported</p> <p>appear to be declining in parts of their range for unknown reasons</p>
Neotropical migratory birds	<p>environmental and habitat conditions affecting population trends</p> <p>continued monitoring, as through Breeding Bird Surveys and tracking trends of habitats</p>
Other birds	<p>effects on ground-nesting birds and their habitats of fire occurrence, fire suppression, season of burn, and changes of vegetation pattern resulting from burns and fire suppression</p> <p>species-specific effects of livestock grazing, changes in distribution and density of nest parasites (brown cowbird)</p> <p>changes in insect populations, and availability of free water</p> <p>monitor trends of arid-land raptors</p>

**Table 5—Research information needs for vertebrates of terrestrial ecosystems of the interior Columbia Basin assessment area, beyond species-specific studies<sup>a</sup> (continued)**

Research subject	Description of research needed
Bats	basic inventory for presence and distribution effects of ectoparasites, pesticides, and timber removal use of substrates for roosts use of forest structures and effects of landscape patterns around roost sites on habitat selection
Carnivores	(species-specific information needs; see Marcot and others, in prep)
Other mammals	monitor status of populations of carnivores and wild ungulates, particularly those potentially impacted by livestock grazing activities

<sup>a</sup> Source: Marcot and others, in prep.

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## Appendix 1

An example of querying the RD&A database on the keyword topic GRAZING, which represents potential effects of livestock grazing on wildlife, or ecology of herbivory of wildlife species. Each of the 29 resulting research study topics is listed with a brief description and statement of potential application. Several research topics were combined in some entries, and in a few cases different research needs were listed separately for the same species.

Description: PYGMY SHREW: STUDY EFFECTS OF GRAZING IN WET MEADOWS, USE OF HERBICIDES & INSECTICIDES, AND INTERACTIONS WITH OTHER SHREWS IN FOREST COMMUNITIES

Potential Applications: PROVIDES BASIC INFORMATION ON SPECIES INTERACTIONS AND EFFECTS OF GRAZING AS AFFECTING POPULATIONS AND DISTRIBUTION

Description: AMERICAN BISON: RELATIONS OF POPULATIONS TO WALLOWS, EARLY SUCCESSION, FORBS & GRASSES, AND ECOLOGICAL DISTURBANCE.

Potential Applications: STUDY WOULD PROVIDE KNOWLEDGE OF HOW ECOSYSTEM PATTERNS AND DYNAMICS AFFECT BISON POPULATIONS. COULD BE BASIS FOR 'ECOSYSTEM MANAGEMENT' OF WILD (CONTROLLED) HERDS.

Description: AMERICAN BISON: HERBIVORY RELATIONSHIPS, ROLE IN SEED DISPERSAL.

Potential Applications: STUDY WOULD PROVIDE INFORMATION ON BISON'S ROLE IN SEED DISTRIBUTION, AND EFFECTS OF HERBIVORY ON PLANT SUCCESSION & PATTERNS. POTENTIALLY IMPORTANT INFORMATION FOR ECOSYSTEM MANAGEMENT OF BISON HERDS IN THEIR ECOLOGICAL CONTEXT AND SETTINGS.

Description: BOBOLINK: BETTER DEFINE GRAZING, HAYING, IRRIGATION, AND POSSIBLY BURNING PRACTICES, AS AFFECTING BOBOLINK POPULATIONS

Potential Applications: INFO COULD DIRECTLY HELP GUIDE AGRICULTURAL DEVELOPMENT, OR AT LEAST BETTER PREDICT EFFECTS ON BOBOLINK POPULATIONS FROM AG DEVELOPMENT

Description: CEDAR WAXWING: STUDY HABITAT ECOLOGY—IMPORTANCE OF WETLANDS FOR NESTING; EFFECTS OF LAND USE ACTIVITIES (LIVESTOCK GRAZING, LOGGING, RECREATION) ON BREEDING & WINTERING HABITATS

Potential Applications: WOULD PROVIDE BASE INFORMATION ON LIMITING FACTORS ON DISTRIBUTION AND POPULATIONS, FOR USE IN FUTURE MANAGEMENT GUIDELINES

Description: COLUMBIAN SHARP-TAILED GROUSE: RESEARCH EFFECTS OF LIVESTOCK GRAZING AND FIRE REGIMES; STUDY MINIMUM ACREAGE OF SUITABLE HABITAT AND MOSAIC PATTERNS OF HABITATS NEEDED TO SUSTAIN POPULATIONS; STUDY EFFECTS OF AGRICULTURAL ENCROACHMENT

Potential Applications: WOULD PROVIDE MUCH INFORMATION ON SUITABLE ENVIRONMENTS FOR MANAGEMENT AND RECOVERY OF THIS SPECIES; IDEAL HABITAT TO SUPPORT Viable POPULATIONS IS UNKNOWN AS MOST POPULATIONS ARE DOWN TO REMNANTS; INTRODUCTIONS LARGELY UNSUCCESSFUL

Description: MERRIAM'S SHREW: STUDY EFFECTS OF GRAZING  
Potential Applications: DETERMINES DEGREE TO WHICH GRAZING MIGHT POSE A THREAT TO THIS SPECIES

Description: PRONGHORN: STUDY EFFECTS OF: FENCES AS BARRIERS TO MOVEMENT, SAGEBRUSH CONVERSION TO GRASSLAND, FIRE SUPPRESSION AND LARGE FIRES ON MAINTENANCE OF SAGEBRUSH HABITATS, HERBIVORY ON SEASONAL NUTRITIONAL VALUE OF RANGES  
Potential Applications: BETTER DEFINES HABITATS USED, BARRIERS TO DISPERSAL, AND EFFECTS OF MANAGEMENT ACTIVITIES (BURNING, GRAZING, FENCING, CONVERSION)

Description: VEERY: STUDY VULNERABILITY TO LIVESTOCK GRAZING AND HABITAT CHANGES FROM GRAZING EFFECTS ON GROUND COVER AND LOWER CANOPY  
Potential Applications: DETERMINES DEGREE OF VULNERABILITY OF POPULATIONS TO GRAZING

Description: WESTERN SCREECH OWL: STUDY EFFECTS OF GRAZING LEVELS ON SHORT- AND LONG-TERM VIABILITY OF POPULATIONS; STUDY DEGREE TO WHICH THEY ARE CAVITY LIMITED VS FOOD LIMITED  
Potential Applications: DETERMINES INFLUENCE OF GRAZING ON POPULATIONS; DETERMINES DEGREE TO WHICH SNAG AND CAVITY MANAGEMENT WOULD AID POPULATIONS

Description: WESTERN WHIPTAIL: STUDY EFFECTS OF LIVESTOCK GRAZING, FIRE SUPPRESSION, OFF-ROAD VEHICLES  
Potential Applications: DETERMINES INFLUENCE OF GRAZING, FIRE, AND OFF-ROAD VEHICLE USE

Description: WILLOW FLYCATCHER: DETERMINE LIVESTOCK GRAZING LEVELS AND GRAZING SEASONS THAT ARE COMPATIBLE WITH PRODUCTIVE NESTING; STUDY COWBIRD PARASITISM (EXTREMELY HIGH IN SOME PORTIONS OF THE REGION); STUDY RELATIONS BETWEEN GRAZING AND PARASITISM LEVELS  
Potential Applications: DETERMINES BEST GRAZING REGIME TO PROVIDE FOR THIS SPECIES

Description: WILLOW FLYCATCHER: DETERMINE DISTRIBUTION AND HABITAT REQUIREMENTS ON WINTERING GROUNDS; STUDY EFFECTS OF FLOODING  
Potential Applications: DETERMINES WINTERING GROUND REQUIREMENTS AS AFFECTING BREEDING POPULATIONS; DETERMINES EFFECTS OF WATER LEVEL ON BREEDING SUCCESS

Description: BURROWING OWL: HABITAT RELATIONS, INCLUDING INFLUENCE OF GRAZING, SAGE TREATMENT, AND CHEATGRASS  
Potential Applications: WOULD PROVIDE INFORMATION ON HABITAT RELATIONS FOR USE IN SPECIFIC MGT GUIDELINES IN SAGE AND CHEATGRASS AREAS

Description: CASCADES FROG: STUDY HABITAT REQUIREMENTS AND POTENTIAL LIMITING FACTORS — WHAT LIMITS THIS SPECIES TO HIGH ELEVATIONS IN MOST REGIONS; GRAZING EFFECTS; EFFECTS OF FOREST CANOPY SHADING; SEASONAL HABITAT SHIFTS  
Potential Applications: WOULD DETERMINE LIMITING FACTORS ON DISTRIBUTION, HELPING TO PRIORITIZE FUTURE MANAGEMENT GUIDELINES

Description: FOX SPARROW: STUDY EFFECTS OF LIVESTOCK GRAZING ON REPRODUCTIVE SUCCESS

Potential Applications: WOULD HELP AMEND GRAZING GUIDELINES, IF NEEDED, TO ACCOUNT FOR POPULATION NEEDS OF THIS SPECIES (LIVESTOCK GRAZING IS DETRIMENTAL TO THIS SPECIES, WHICH IS DEPENDENT ON DENSE GROUND COVER FOR NESTING AND FORAGING)

Description: LINCOLN'S SPARROW: APPEARS TO BE PRESENT IN SUITABLE HABITAT; MONITORING IS DESIRABLE BUT NO PROBLEMS ARE EXPECTED AS LONG AS LIVESTOCK GRAZING IS PROPERLY MANAGED

Potential Applications: MONITORING WOULD HELP DETERMINE POPULATION STATUS AND TREND IN AREAS OF EXCESSIVE LIVESTOCK GRAZING; MIGHT PROVIDE INFORMATION ON GRAZING THRESHOLDS THAT CAN ALSO SUPPORT POPULATIONS

Description: MOOSE: STUDY INFLUENCE OF FIRE MANAGEMENT, GRAZING, AND LOGGING ON FORAGING DYNAMICS

Potential Applications: DETERMINES DEGREE TO WHICH EFFECTS OF LAND MANAGEMENT ACTIVITIES AFFECT POPULATIONS, TO WEIGH AGAINST POTENTIAL EFFECTS OF INTERSPECIFIC COMPETITION WITH OTHER UNGULATES (CATTLE, ELK)

Description: PRAIRIE FALCON: STUDY LONG-TERM POPULATION FLUCTUATIONS AND THEIR CAUSES; STUDY INTERACTIONS WITH PEREGRINE FALCONS; STUDY EFFECTS OF GRAZING ON PREY BASE

Potential Applications: DETERMINES INTERSPECIFIC INTERACTIONS, GRAZING EFFECTS, AND POPULATION TRENDS

Description: PREBLE'S SHREW: STUDY FOOD HABITS, EFFECTS OF RIPARIAN GRAZING, KEY HABITATS (LIT. SUGGESTS MARSHES OR DRIER ALPINE) THROUGHOUT RANGE (MAY VARY; ASSOC. WITH WET AREAS IN E. OREGON, AND SAGEBRUSH/DRY FORESTS AWAY FROM WATER IN MONTANA)

Potential Applications: DETERMINES POTENTIAL VULNERABILITY TO GRAZING, AND DEGREE OF LOCAL ECOTYPIC SPECIALIZATION ON HABITATS

Description: ROCKY MOUNTAIN ELK: STUDY TEMPORAL PROFILES OF DIGESTIBLE ENERGY (DE) AVAILABILITY, BY COMMUNITY; STUDY INFLUENCE OF HERBIVORY ON VEGETATION; DETERMINE INTERACTIVE INFLUENCES OF HERBIVORY & OTHER DISTURBANCES ON DE PROFILES

Potential Applications: BETTER DETERMINES HERBIVORY ECOLOGY EFFECTS ON HERD PRODUCTIVITY (DE) AND ON VEGETATION STRUCTURE

Description: SAGE GROUSE: STUDY GRAZING IMPACTS ON HABITAT, ROLE OF INTRODUCED CHEATGRASS

Potential Applications: DETERMINES HOW GRAZING AND EXOTIC PLANTS AFFECT HABITAT SUITABILITY, FOR POTENTIAL USE IN MANAGEMENT GUIDELINES

Description: SANDPIPER/WILLET/GODWIT/CURLEW/PLOVER GROUP: DETERMINE POPULATION TRENDS IN CRB (SOME DATA FROM NAT'L REFUGES AND COASTAL WINTERING AREAS); STUDY EFFECTS OF GRAZING, FIRE, HERBICIDES, DROUGHT ON NESTING HABITAT; EFFECTS OF PESTICIDES ON PREY BASE

Potential Applications: DETERMINES POPULATION STATUS AND POTENTIAL REASONS FOR DECLINES

Description: WATER SHREW: STUDY EFFECTS OF WATER QUALITY CHANGES, AND EFFECTS OF LOGGING AND GRAZING ON POPULATIONS, INCLUDING SILTATION AND WATER TEMPS, AND THEIR EFFECTS ON SHREWS AND AQUATIC INSECT PREY

Potential Applications: DETERMINES IF LOGGING AND GRAZING ARE DETRIMENTAL, TO WHAT DEGREE, AND IN WHAT WAY

Description: WESTERN WOOD-PWEE: STUDY IMPORTANCE OF RIPARIAN WOODLAND VS. CONIFEROUS FOREST FOR BREEDING HABITATS; AND EFFECTS OF LAND-USE ACTIVITIES (GRAZING, RECREATION, LOGGING) ON BREEDING HABITATS

Potential Applications: DETERMINES INFLUENCE OF MGT ACTIVITIES ON REPRODUCTION AND POPULATIONS

Description: MOUNTAIN GOAT: STUDY EFFECTS OF FIRE SUPPRESSION ON LOSS OF EARLY SUCCESSION HABITAT USED BY THIS SPECIES; ALSO EFFECTS OF PRESCRIBED BURNING AND OTHER DISTURBANCES (LIVESTOCK GRAZING, LOGGING) ON AVAIL. OF FORAGE AND ITS QUALITY

Potential Applications: DETERMINES EFFECTS OF LAND MGT ACTIVITIES ON HABITAT

Description: SPOTTED FROG: STUDY RELATION WITH INTRODUCED FISH AT HIGH ELEVATION PONDS, EFFECTS OF WATER LEVEL AND USE ESPECIALLY IN SW IDAHO; EFFECTS OF GRAZING HABITAT, FOREST CANOPY SHADING ON WATER TEMP OF WETLANDS, AND INTRODUCED PREDATORS

Potential Applications: DETERMINES SPECIES INTERACTIONS AND EFFECTS ON HABITATS FROM GRAZING, AS AFFECTING POPULATIONS

Description: COMMON SNIPE: STUDY HABITAT PREFERENCES AT VARIOUS ELEVATIONS AND WITHIN VARIOUS FOREST TYPES; STUDY EFFECTS OF LOGGING, FIRE, & GRAZING ON POPN DENSITY; DISTRIBUTION AND NUMBERS IN CRB ARE POORLY KNOWN

Potential Applications: WOULD DETERMINE DISTRIBUTION, DENSITIES, AND SPECIFIC HABITAT CONDITIONS FOR MGT GUIDELINES

Description: ORANGE-CROWNED WARBLER: STUDY EFFECTS OF OPENING RIPARIAN AREAS TO PREDATORS, OF LOSS OF RIPARIAN HABITAT FROM INTRODUCTION OF LIVESTOCK; STUDY USE OF RIPARIAN CORRIDORS FOR MIGRATION AND DISPERSAL

Potential Applications: DETERMINES CONFLICTS OR COMPATIBILITY WITH RIPARIAN GRAZING AND MGT

## **Appendix 2**

Metadata documentation on the RD&A database on animals of the interior Columbia River basin and northern portions of the Klamath and Great Basins.

The RD&A database is formatted for Paradox. It is available on the World Wide Web at URL <http://www.fs.fed.us/pnw/marcot.html>. The following metadata documentation describes the database fields of this file. Each record in the database consists of a separate research or information need for an individual species or species group. See table 1 for definitions of keywords.

<b>Field name</b>	<b>Field type</b>	<b>Field description</b>
Desc	A255	Description of information need
Key1	A15	1st keyword
Key2	A15	2d keyword
Key3	A15	3d keyword
Key4	A15	4th keyword
Key5	A15	5th keyword
Key6	A15	6th keyword
Potappl	A255	Description of potential application



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